



ON THE NATURE, CAUSE, AND PREVENTION OF SCURVY.

By ALFRED B. GARROD, M.D.,

ASSISTANT PHYSICIAN TO UNIVERSITY COLLEGE HOSPITAL, LONDON.

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HAVING for many years paid considerable attention to the application of chemistry in the investigation of disease, the subject of scurvy has frequently presented itself to my mind; and, as there is but little doubt that the disease arises from some alteration in the animal fluids and solids from error of diet, I have always considered that it was in the power of chemistry to unravel the mystery. During the early part of the present year, many cases came under my care at University College Hospital: this led me again to pay particular attention to the subject, and to examine the peculiarities of the food, and other causes, which could have produced the disease at that time; for until then I had scarcely seen a case of scurvy in London.

It is not my intention to detail the symptoms which presented themselves in my scorbutic patients. I have however noticed, that the solid effusions in the ankles, with petechiæ and discoloration of the lower extremities, have, in several cases, preceded the spongy condition of the gums; there has also been the sallow skin, great muscular weakness, with rheumatic pains; but these have been so recently and ably described in *The Monthly Journal* by Drs Christison, Ritchie, Lonsdale, &c., and in many other recent periodicals, that it is unnecessary to recapitulate them.

Causes of Scurvy.—From the different writers on scurvy it appears, that although impure air, cold, moisture, age, and condition of

habit, may favour the occurrence of this disease; yet no one of them can be regarded as the real cause, which must be sought for in the nature of the food. This is fully proved in the writings of Lind, Trotter, Budd, Christison, Curran, Ritchie, &c. It appears also, that it is due to the *absence* of some essential ingredient in the food, and not from the *presence* of any noxious substance; for the use of salt in large quantities is certainly not a cause, many of the most severe cases of disease having occurred where no such diet had been used, and sea water has never been found to aggravate the symptoms of the sufferers. The causes of the disease are thus reduced to one of the two following, viz. :—

1st, To the absence or deficiency of some *organic* substance in the food.

2d, To the absence or deficiency of some *inorganic* constituent.

There are many facts to support the opinion, that it is some organic constituent that is deficient in the food, and this is usually believed to be of an acid nature; for it is generally found that scurvy has appeared when there has been a want of succulent vegetables, and that the disease is easily cured whenever they can be supplied in abundance: these succulent vegetables mostly contain some organic acid. It has also been found that fruits, from the order Aurantiaceæ, containing much of such acids, are highly anti-scorbutic. But there are many objections to this view; for although fruits and vegetables containing these acids are exceedingly useful, yet the acids themselves, when separated, are not so, and I am informed, on good authority, that citric acid has been used and found not to be anti-scorbutic; the same remark applies to acetic acid. Again, carnivorous animals live entirely on meat without suffering from such disease, and infants will sometimes live for eighteen months on milk and not show any scorbutic symptoms. Milk is also found to act as an excellent remedy in scurvy, although, when fresh, it contains no organic acid. These facts are therefore sufficient to show, that it is not to the absence or deficiency of organic acids in the food that scurvy is due.

Dr Christison thinks that the main peculiarity in scorbutic diet is the deficiency in the quantity of animal nitrogenized principles, and that this may be effectually counteracted by milk, and other nitrogenized articles of food from the animal world. He also thinks that potatoes may owe their anti-scorbutic properties to the albumen contained in them; but if we only examine the diets under which some patients become scorbutic, and others under which they remain in a healthy condition, we must be at once convinced that it is not from the want of nitrogenized principles that the disease arises; for we observe in the diet of sailors who become scorbutic, abundance of these principles, and in many of our union workhouse and prison dietaries, they are very much reduced in quantity; yet no such disease arises when a few pounds of potatoes are added per week, although the amount of albuminous matters contained in them is far

from sufficient to make the total quantity of such principles equal to that found in many scorbutic diets. Again, if this theory were true, why should so very small an amount of fruits, and succulent vegetables, act in so surprising a manner in curing the disease?

Some have supposed that vegetable acids are not required, but that there exists a *something* in fresh vegetables which acts by a kind of catalytic power, and which is necessary to cause certain changes to take place in the body by its presence; but as there is no proof of such an hypothesis, we will not stop to consider it.

We have not, then, found that the absence or deficiency of any organic constituent of the food can be proved to be the real cause of scurvy.

The analyses of blood hitherto made, have not thrown any light on the cause or nature of this disease. Recent examinations have shown that the blood is not in a dissolved state as was formerly supposed, but that the globules are normal in appearance, and the clot firm, and frequently buffed and cupped. The fibrin has been found in excess by Busk, Becquerel and Rodier. I have also observed a small firm clot in scorbutus, sometimes also it has been cupped and buffed. The red globules and organic matters of serum have been generally observed to be deficient, so that the blood appears to be *impoverished* in its nature.

The saline matters in the serum have been found in about the normal proportions. In the analyses which I made—one of healthy, the other of scorbutic blood—I found in the former 100 parts of dried serum gave 7·609 of inorganic matters—in the latter, 8·125; but if the density of the serum in scurvy is less than in health, the 100 parts of dried matters corresponded to a larger amount of serum.

Finding that all the theories of scurvy hitherto advanced were imperfect, I was led to examine more minutely the composition of food under the use of which scurvy was capable of occurring, and also of such substances as had been proved beyond doubt to be anti-scorbutic, and afterwards to seek for the absence or deficiency of certain normal substances in the blood; and from such examinations I was led to the following conclusions:—

1st, That in all scorbutic diets, *Potash* exists in much smaller quantities than in those which are capable of maintaining health.

2nd, That all substances proved to act as anti-scorbutics contain a large amount of *Potash*.

3d, That in scurvy the blood is deficient in *Potash*, and the amount of that substance thrown out by the kidneys less than that which occurs in health.

4th, That scorbutic patients will recover when *Potash* is added to their food, the other constituents remaining as before, both in quantity and quality, and without the use of succulent vegetables or milk.

5th, That the theory which ascribes the cause of scurvy to a

deficiency of *Potash* in the food, is also capable of rationally explaining many symptoms of that disease.

Before attempting to prove any of these propositions, I will give a table containing the amount of potash contained in several articles of diet. The potash was determined by forming the double salt with the bichloride of platinum ($KC + Pt Cl_2$), $\frac{19.33}{100}$ giving the per centage of potash (KO).

Analyses showing the amount of potash (KO) in 1 ounce avoirdupois of the following substances :—

	Grains
1 oz. of Baker's Best Bread (City),.....	0.259
1 oz. of Best Bread (West End),.....	0.257
1 oz. of Home-made Bread, probably containing potatoe flour,	0.262
1 oz. of Best White Flour.....	0.100
1 oz. of Bran,	0.609
1 oz. of Rice,	0.005
1 oz. of Rice,	0.011
1 oz. of Oatmeal.....	0.054
1 oz. of Split Peas,.....	0.529
1 oz. of Raw Beef,.....	0.599
1 oz. of Salt Beef, raw,	0.394
1 oz. of Salt Beef, boiled (slightly salted),	0.572
1 oz. of Boiled Mutton,	0.637
1 oz. of Dutch Cheese,	0.230
1 oz. of Boiled Potato of large size,	1.875
1 oz. of Raw Potato (small),	1.310
1 oz. of Boiled Potato, without peel and well done, water containing much potash,.....	0.529
1 oz. of Onion (small),.....	0.333
1 fluid oz. of London Milk,	0.309
1 oz. of Orange (not ripe) including septa,	0.675
1 fluid oz. of Lime Juice,.....	0.852
1 fluid oz. of Lemon Juice,	0.846

(1.) *Potash is deficient in scorbutic diets.*—This is easily proved by examining some of the dietaries of Union workhouses and prisons, when the inmates have become scorbutic. Thus in the Crediton Union, see *Provincial Medical and Surgical Journal*, June 1847, the usual weekly dietary consisted of—

	Men.	Women.
Bread, . . .	102 oz.	85 oz.
Cooked Meat, . . .	12 —	12 —
Soup, . . .	3 pints,	3 pints.
Broth, . . .	4½ —	4½ —
Cheese, . . .	8 oz.	8 oz.
Rice, or Suet Pudding, . . .	14 —	14 —
Potatoes, . . .	4½ lbs.	4½ lbs.

If we estimate the amount of potash taken by the inmates of this workhouse, we shall find the men's food to contain about 186 grains, and the women's about 181 grains. This amount would be much influenced by the mode in which the potatoes were cooked; if not too much boiled, and with the skins on, they would contain a much

larger amount of potash than if boiled without their skins, and much done. Under this diet the inmates remained healthy; but, owing to the scarcity of potatoes, boiled rice in equal weights was substituted, and in a few months the inmates became scorbutic. When the substitution was made, the weekly amount of potash taken by the men was about 51 grains, and by the women 46 grains, or a reduction of more than two-thirds took place. Rice and potatoes do not differ much in their composition, except in the salt of *potash* contained by the latter. Both contain starch and vegetable albumen. In the weekly diet list for the military prisoners at the Milbank Penitentiary, when they were subject to scurvy, (see Dr Baly's paper in *London Medical Gazette*, Vol. I. 1841-2,) we find the amount of potash taken by each prisoner during the first three months of imprisonment to be about 44 grains; during the second three months, about 50 grains; after six months, about 68 grains. At present, when potatoes are added, the weekly amount of potash is from 210 to 230 grains, and no case of scurvy has arisen since the change.

Again, if we examine some of the diets used by the labourers suffering from scurvy, and detailed in the last July number of this Journal, we shall perceive that the weekly amount of potash varied from 20 to 80 or 90 grains, and that this was contained chiefly in the bread, the analysis of which gave a much greater amount than the corresponding quantity of flour, thus indicating some admixture, as of alum and potatoe flour.

In the cases which have occurred under my care, the diets have consisted chiefly of bread, butter, little or no milk, and no potatoes, occasionally a small piece of meat, bacon, or a salt herring, and a similar diet has been found to have been used by most patients who have become scorbutic within the last year. (See paper on scurvy by Dr Curran, in *Dublin Quarterly Journal* for August 1847, and by Dr Shapter, in the *Provincial Medical and Surgical Journal*).

In the diet of sailors we find abundance of meat (salted beef and pork); but no doubt the quality of these provisions is often much impaired by the prolonged action of the salt, causing the gradual exosmosis of the potash salts, and the substitution of those of soda. In an analysis of beef which has been exposed for only a few days to the action of brine, but where the thickness of muscle was not more than $1\frac{1}{2}$ inch, there was found to be a considerable diminution of the potash. One oz. of fresh beef gave 0.599 grains of potash, one oz. of salted beef 0.394 grains; and there can be little doubt but that a prolonged action of the brine would reduce very greatly the amount of potash salts in the largest joints. So that the sailors' weekly dietary, when no vegetables can be procured, consisting of $9\frac{3}{4}$ lbs. of salted meat, about 7 lbs. of flour in the form of biscuits, and $1\frac{1}{2}$ pints of peas, would contain about 90 grains of potash, supposing the meat such as stated above.

(2.) *That all bodies proved to be anti-scorbutic contain a large*

amount of Potash.—All fruits contain this substance in abundance, as oranges, lemon, limes, grapes, gooseberries, &c., and these are all highly anti-scorbutic. Potatoes also, which perhaps are the most valuable as an addition to a dietary for the purpose of preventing scurvy, and owing to the scarcity of which article this disease has been so prevalent within the last two years, contain, as the above analyses prove, a very large amount of potash, and when boiled (not too much, and unpeeled), still retain most of that ingredient; this also accords with the fact, that potatoes, when cooked in the ordinary way, are anti-scorbutic, and at the same time explains why the hard core of that tuber, which is so much liked by the Irishman, is most powerful in preventing the occurrence of scurvy, (see Dr Lonsdale in August number of this Journal). Milk, which is undoubtedly a good anti-scorbutic, and upon which the young of animals are for some time sustained, contains a very large proportion of potash salts compared with those of soda, being an exception to the relation between these two classes of salts which is found in the other animal fluids,—a pint of milk (London) and having a sp. gr. of 1·021, containing 6·180 grains. This was probably considerably diluted, as the usual sp. gr. is from 1·026 to 1·030. Berzelius's analysis gives about 9 grains; but the sp. gr. of the milk which he analyzed was much greater, about one-third. Fresh meat also contains potash in rather large proportion; and there is no doubt that animals, such as the carnivora, living entirely on this substance in its uncooked state, take an amount of potash quite sufficient for the wants of the system. When we examine other articles noted for preventing or curing the disease in question, we find that potash enters into the composition of all in considerable quantities; this is true with regard to cabbages, turnips, onions, garlies, leeks, and hence their efficacy, and also of pickles and sour-kROUT made from them; the same is the case with the young tops of plants, as of the *Pinus sylvestris*, &c., when a decoction is made. Potash is also found in spruce beer, wort, malt liquors, wines, especially the lighter description, which contain this substance in the form of a bitartrate, but which becomes deposited in the stronger varieties.

(3.) *In scurvy the blood is deficient in potash, and the amount of that substance thrown out by the kidneys is less than what takes place in health.*—100 grains of the dried serum of healthy blood, when incinerated and heated with the bichloride of platinum, gave 1·582 grains of the double chloride of potassium and platinum. 100 grains of dried serum of scorbutic blood, treated in the same way, gave only 0·627 grains of the same salt; so that the amount of potash in scorbutic blood was little more than one-third that contained in the blood in health, although the total amount of saline matters was nearly equal. In one case, a female, at 50, complaining of great prostration of strength, spongy gums, effusion in both ankles, &c., the amount of urine passed was $22\frac{1}{2}$ fluid ounces in the twenty-four hours—sp. gr. 1·015. Reaction *very* acid, and on standing deposited mucus

intermixed with uric acid crystals. The amount of potash excreted in twenty-four hours was much less than in health, being less than 7 grains; but a slight accident prevented a very accurate determination of the quantity.

In another case, the amount thrown out in twenty-four hours was 40 oz. Sp. gr. 1·010, and acid in its reaction.

(4.) *Scorbutic patients, when kept under a diet which gave rise to the disease, recover, when a few grains of Potash are added to their food.*—In several cases which came under my care, the treatment consisted in the daily administration of a few grains (from 12 to 20) of some salt of potash mixed with syrup and water. Sometimes the bitartrate, at other times the acetate, and also the carbonate and phosphate were used. All the salts appeared to act alike, and I have little doubt but the chloride of potassium would be found equally efficacious. When the cases were thus treated, all vegetables, milk, and malt liquors were strictly prohibited; and yet the patients rapidly recovered. Other cases were treated by fresh vegetables and milk; these also recovered, but certainly not more quickly than those from whom these substances were withheld, and potash salts substituted. On looking over the works of several writers on scurvy, I have frequently found that some *Potash* salt has been administered with *marked* benefit; thus, nitre has been recommended, nitre dissolved in vinegar, the bitartrate of potash, the oxalate of potassa; but the efficacy has always been ascribed to the acid contained in these substances, and no attention has been paid to the base.

(5.) *The theory which ascribes the cause of scurvy to a deficiency of Potash in the system, is capable of explaining some of its symptoms.*—Both soda and potash are constant constituents of the animal body, and it appears that they are not capable of replacing each other; for example, we always find the potash to exist in large quantities in the ash of muscle, soda in very small quantities (Berzelius, Liebig); in the ash of the blood we find the relation reversed. It appears also, that the muscular system requires the presence of potash, and we should therefore expect to find that where there is a deficient supply of this base, the effect would soon be manifested in the functions of that system. This we find to be the case in scurvy; without any amount of wasting of the body we find marked muscular debility, and this perhaps is one of the earliest symptoms of the disease.

Conclusion.—I have ventured to make public this theory of the cause and nature of scurvy sooner than I otherwise wished, both on account of the difficulty of procuring cases of this disease at the present time, and from the conviction that its being made known to the profession at large would be the most ready mode of having it confirmed or disproved. If true, it will be seen at once that its applications will be of the utmost importance, and the occurrence of scurvy, both at sea and on land, can be most readily prevented, by the introduction of a few grains of some potash salt, as the phosphate, chloride, tartrate, &c., into the food, or by these being taken in a separate

state. At sea, its applications would be invaluable, from the cheapness, stability, and the small space occupied by the remedy, when compared with lime juice; from its being able at all times to be procured from the ashes of wood or plants, especially tobacco, which contains it in abundance. If found to be a mere hypothesis, I have this apology to make, that in my mind it accounts better for the occurrence of this disease than any other yet offered; and it will still be an interesting fact, that *Potash* always accompanies the *real* anti-scorbutic principle, was found deficient in scorbutic blood, and that several cases of scurvy rapidly recovered under the use of some of its salts, without the administration of any other remedy, dietetical or medicinal.